

## Perilaku korosi glass fiber-reinforced unsaturated polyester resin jenis orthophthalic dengan gelcoat dalam larutan asam nitrat dan hidrogen peroksida

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### Abstrak

Fiber Reinforced Plastic (FRP) sudah banyak digunakan di berbagai bidang, seperti konstruksi bangunan, industri perkapalan, dan berbagai saluran pipa (pipeline). Penggunaan FRP sebagai bahan konstruksi di industri seperti tangki penyimpanan, pipa, dan lain-lain sudah mulai berkembang. Sebagai bahan yang lebih tahan korosif dibandingkan dengan logam, maka FRP berpotensi untuk dipakai sebagai bahan konstruksi tangki penampung zat-zat kimia korosif, seperti asam nitrat dan hidrogen peroksida, yang pada saat ini masih banyak menggunakan logam.

Dalam penelitian ini dilakukan pengamatan terhadap korosi glass fiber-reinforced unsaturated polyester resin jenis orto (UPR-fiber glass) dengan gelcoat di dalam larutan asam nitrat ( $\text{HNO}_3$ ) 40%, 50%, dan 60% dan hidrogen peroksida ( $\text{H}_2\text{O}_2$ ) 10%, 20%, dan 30%. Perendaman dilakukan pada suhu  $50^\circ\text{C}$ . Setelah spesimen direndam di dalam larutan selama waktu tertentu, dilakukan analisis terhadap larutan dan spesimen yang tersisa.

UPR-fiber glass yang telah direndam di dalam larutan asam nitrat dan hidrogen peroksida mengalami penurunan sifat mekanik, yang meliputi kekerasan (Barcol), flexural strength, dan flexural modulus. Pada awal perendaman terjadi penambahan berat spesimen sampai waktu tertentu dan kemudian mengalami penurunan. Selain itu larutan perendam juga mengalami penurunan konsentrasi. Secara visual, UPR fiber glass mengalami perubahan warna. Di dalam larutan  $\text{HNO}_3$ , sisi UPR-fiber glass dengan gelcoat berubah warna dari biru menjadi hijau muda, sementara sisi UPR-fiber glass tanpa gelcoat berubah dari bening menjadi kuning. Di dalam larutan  $\text{H}_2\text{O}_2$ , sisi gelcoat mengalami perubahan warna dari biru menjadi biru muda sampai putih kebiruan sementara pada sisi UPR-fiber glass tanpa gelcoat terlihat garis-garis putih yang tak lain adalah serat gelas. Dengan menggunakan SEM, dapat dilihat kerusakan struktur fisik spesimen yang telah direndam di dalam larutan  $\text{HNO}_3$  dan  $\text{H}_2\text{O}_2$ .

Dengan menggunakan FT-IR, dapat diperkirakan reaksi yang terjadi pada UPR-fiber glass di dalam  $\text{HNO}_3$  adalah reaksi hidrolisis gugus ester menjadi karboksilat dan alkohol, reaksi oksidasi gugus alkohol menjadi asam karboksilat dan keton, dan reaksi pembentukan alkil nitrat. Sementara pada UPR-fiber glass di dalam  $\text{H}_2\text{O}_2$  dapat diperkirakan terjadi reaksi oksidasi alkohol yang menghasilkan senyawa karboksilat, aldehid dan keton.

Fiber Reinforced Plastics (FRP) has been used in a wide range of applications such as building construction, shipbuilding industries, and various pipelines. The using of FRP as a construction material in industries, such as storage and pipes, has been developing. FRP as a material which has more corrosive resistant than metal, has a potential usage in industrial application, especially in the implementation of FRP for nitric acid and hydrogen peroxide environment.

This research is to observe corrosion behavior of glass fiber-reinforced orthophthalic unsaturated polyester resin with gel coat in nitric acid (HNO<sub>3</sub>) and hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>). The concentration of HNO<sub>3</sub> and H<sub>2</sub>O<sub>2</sub> are [40%, 50%, and 60%] and [10%, 20%, and 30%], respectively, the immersion temperature was 50°C. After the specimens are immersed in the solution for a certain length of time, the analysis of the remaining solution and the specimen was performed.

UPR-fiber glass which has been immersed in the nitric acid and hydrogen peroxide solutions underwent a decrease of mechanical properties. These mechanical properties consist of hardness (Barcol), flexural strength, and flexural modulus. On the beginning of the immersion, the weight specimen was gained for a certain time, and then gradually decreased. The immersion solution concentration was decrease as well. By visual observation, the color of UPR was changed. in nitric acid solution, the side of UPR with gel coat turned from blue into light green. In the same condition, the part of UPR without gel coat changed from colorless into yellow. In hydrogen peroxide solution, the side of UPR with gel coat turned from blue into light blue, and finally into bluish white. While at the other side, the fiberglass in a form of white lines was also seen. Through SEM observation, the deterioration of the specimen's physical structure after immersion in a certain time into the solution can be seen.

From infrared spectra (FTIR), it is expected that the reactions occurred to UPR in the nitric acid solution were a hydrolysis reaction of ester groups into carboxylic and alcohol, oxidation reaction of alcohol group into carboxylic acid and ketone, and the forming of nitric alkyl. Regarding the UPR in a hydrogen peroxide, it is predicted that an oxidation reaction of alcohol resulting in carboxylic, aldehyde, and ketone groups, occurred.